Hints, Tips and Solutions

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Q. EXACT has powerful scripting utilities for manipulating the final capacitance data and variables but is there an easier graphical front end that would also allow me to view the data ?

A. Recent improvements to ***EXACT*** have included the addition of the Worksheet utility. When an experiment has been completed within ***EXACT*** the Worksheet may be accessed from the "View-->Data" pulldown menu of the main ***EXACT*** window shown in Figure 1. All the data from the experiment, including selected layers, process variables, layout variables and extracted capacitance data, will be sent to the Worksheet. An example of this is shown in Figure 2 where columns are shown for the test structure name, the chosen process layer names, the layout parameter that has been varied and finally the calculated capacitance values from ***EXACT***.

The worksheet allows a number of operations to be performed which include;

- column/row selection
- inter-column or inter-row calculations into new columns or rows respectively
- selection of data for plotting in ***TonyPlot***
- selection of data that can then be sent to ***SPAYN*** for statistical analysis
- equation fitting through the use of the Silvaco Optimiser

The Worksheet allows a graphical approach to viewing the variables and data that otherwise would be accessed only through the ***EXACT*** script utilities. As an example of this we can select certain data, as shown in Figure 3, which we wish to view. Once selected the Worksheet pulldown menu option "Selection-->Tonyplot" will then

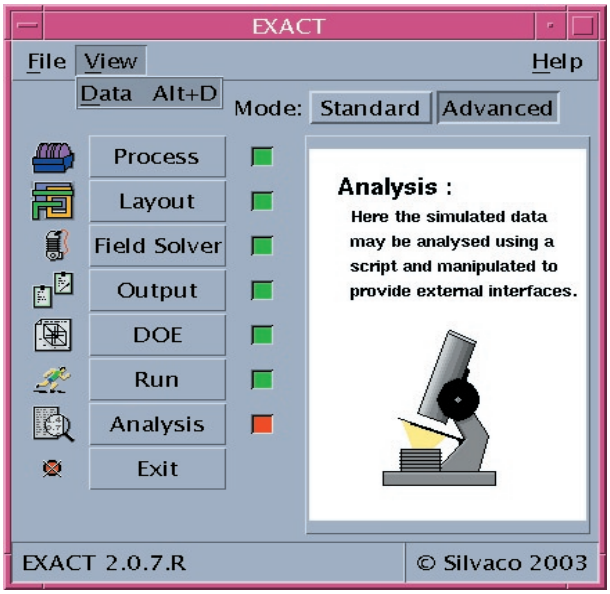

Figure 1. Once the ***EXACT*** experiment has been run the data may be accessed through the Worksheet.

send this data to ***TonyPlot***. Figure 4 shows the selected data from Figure 3 where the measured capacitance values (B_Gnd_L1l, B_Gnd_L1p, B_Gnd_L1r, L1l_L1p, L1l_L1r and L1p_L1r) have been plotted against the layout variable LAYER1SPACE.

Many other features are available through this Worksheet which shall be described in future publications.

Q. *EXACT* allows the measured data to be fitted to polynomial expressions using the scripting utilities. Is there a way to instead optimise the fitting interactively ?

A. Figure 5 shows a script which performs an interactve optimization. A detailed description of the syntax in this script is available in the ***EXACT*** *User's Manual*. In step 1

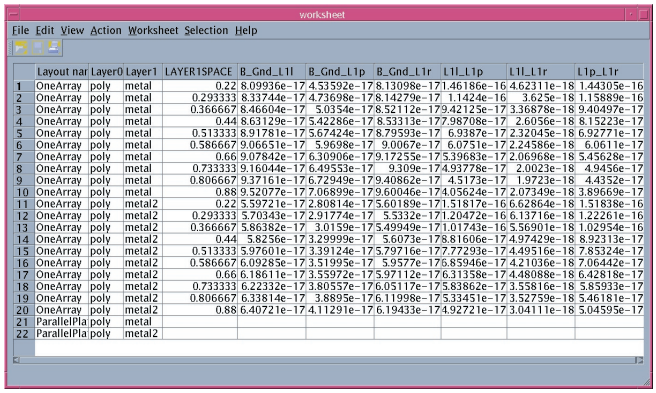

Figure 2. The ***EXACT*** Worksheet showing the data from the experiment.

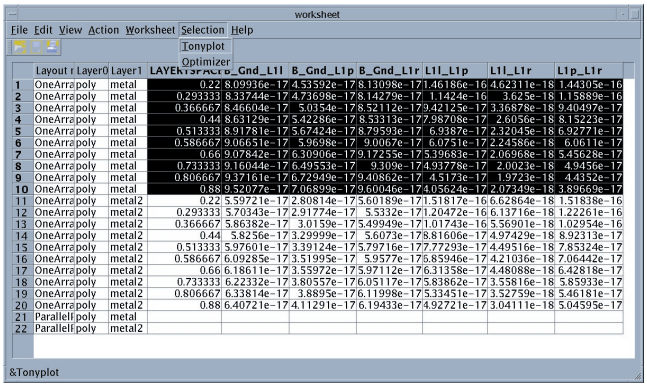

Figure 3. Selection of data in the Worksheet to be sent to ***TonyPlot***.

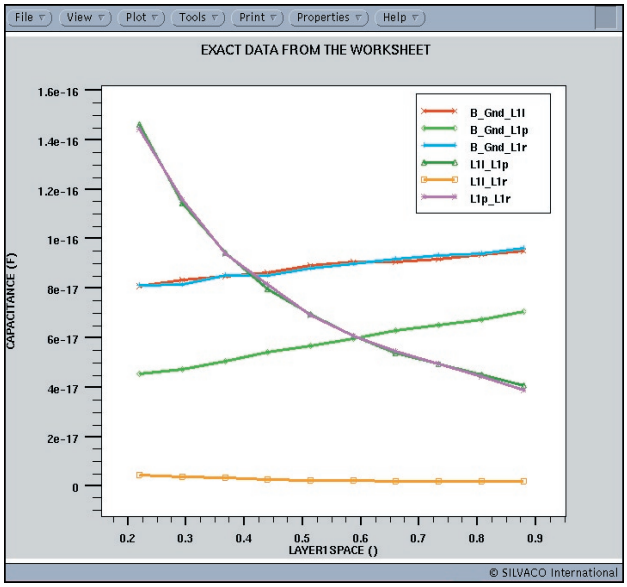

Figure 4. Data from the Worksheet plotted within ***TonyPlot***.

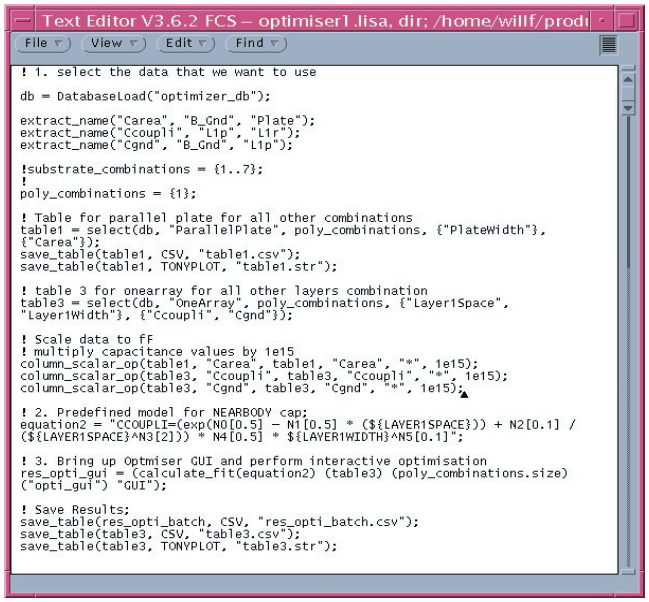
Text Editor V3.6.2 FCS – optimiser1.lisa, dir: /home/willf/prodi
File
View
Edit
Find
! 1. select the data that we want to use
db = DatabaseLoad("optimizer_db");
extract_name("Carea", "B_Gnd", "Plate");
extract_name("Ccoupli", "L1p", "L1r");
extract_name("Cgnd", "B_Gnd", "L1p");
!substrate_combinations = {1..7};
!
poly_combinations = {1};
! Table for parallel plate for all other combinations
table1 = select(db, "ParallelPlate", poly_combinations, {"PlateWidth"},
{"Carea"});
save_table(table1, CSV, "table1.csv");
save_table(table1, TONYPLOT, "table1.str");
! table 3 for onearray for all other layers combination
table3 = select(db, "OneArray", poly_combinations, {"Layer1Space",
"Layer1Width"}, {"Ccoupli", "Cgnd"});
! Scale data to fF
! multiply capacitance values by 1e15
column_scalar_op(table1, "Carea", table1, "Carea", "*", 1e15);
column_scalar_op(table3, "Ccoupli", table3, "Ccoupli", "*", 1e15);
column_scalar_op(table3, "Cgnd", table3, "Cgnd", "*", 1e15);
! 2. Predefined model for NEARBODY cap:
equation2 = "CCOUPLI=(exp(N0[0.5] – N1[0.5] * (${LAYER1SPACE})) + N2[0.1] /
(${LAYER1SPACE}^N3[2])) * N4[0.5] * ${LAYER1WIDTH}^N5[0.1]";
! 3. Bring up Optmiser GUI and perform interactive optimisation
res_opti_gui = (calculate_fit(equation2) (table3) (poly_combinations.size)
("opti_gui") "GUI");
! Save Results;
save_table(res_opti_batch, CSV, "res_opti_batch.csv");
save_table(table3, CSV, "table3.csv");
save_table(table3, TONYPLOT, "table3.str");

Figure 5. ***EXACT*** script for performing the analysis on the experiment data.

in the script the capacitance database is loaded and various selections are made that result in a table of variables and data that we wish to work with, which in this case is the NEARBODY capacitance (which is the capacitance effect between two conductors edge-to-edge). The capacitance data from ***EXACT*** is in the units of Farads but for the purposes of fitting the script scales these values into units of femtoFarads. In step 2 we define an equation that will be used to fit the data to and in step 3 we force the optimiser to come up in interactive mode.

Figure 6 shows the Optimser window that appears within which the user can modify the equation, set up the optimization Control paramters and view the results of the ptimisation. In this case we show the variations of the equation coefficients (N0, N1, N2, N3, N4, N5) during the optimisation iterations.

When the optimisation has finished the original data from ***EXACT*** and the fitted equation, with the optimised parameters, may be plotted in ***TonyPlot***. As shown in Figure 7 an excellent fit is obtained.

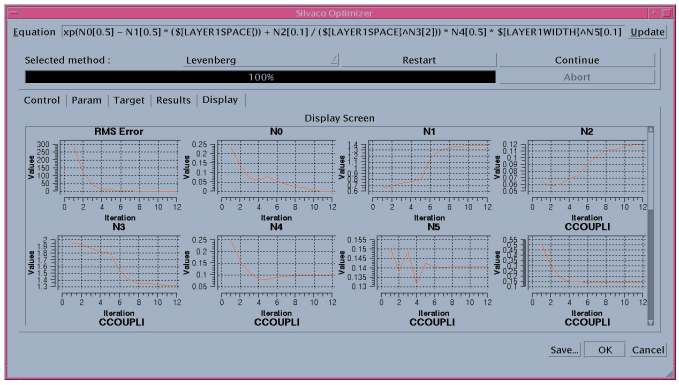

Figure 6. The ***Optimizer*** window that allows interactive control of the fitting process.

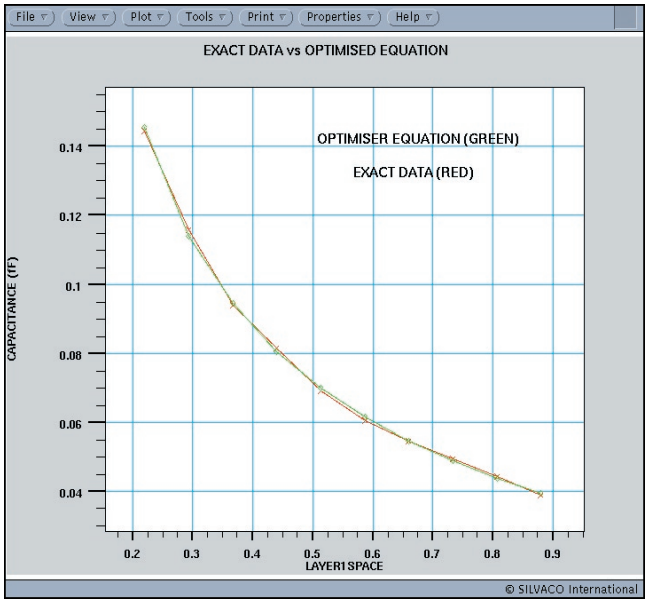

Figure 7. Comparison of the original EXACT capacitance data and the equation used to fit the data which has the optimised coefficents.

Acknowledgments to Eric Guichard and his team for this Hints and Tips.

Call for Questions

If you have hints, tips, solutions or questions to contribute, please contact our Applications and Support Department

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